

Question 1.

Provide two real world examples of computer systems which combine 2 out of 3 classes of fault tolerant systems described in the class. Explain briefly your answer.

Example 1:

Space Satellite

Space satellite is the primary example of system which requires ultra reliability as well as long life. For early time period satellite must be ultra reliable when it start to move for space. Once it fix in space then long life reliability is necessary since repair / maintenance is not possible.

Example 2:

Nuclear Power Plant

Nuclear power plant typically have a combination of ultra reliable and long life systems. The used cooling rod operation must would be long life because they must always work and be restricted to especially environmental faults. In other hand control systems would be ultra reliable.

Question 2

Explain your answer

What kind of redundancy best suited for permanent faults ?

Hardware redundancy is best suited for permanent faults. Permanent faults are usually caused by the hardware problems, which can be defects during manufacturing or stress during the normal operation. Therefore if one system fails we can use another system.

What kind of redundancy best suited for transient faults ?

Time redundancy is best suited for transient faults. Transient faults can appear and disappear within a very short period of time. The basic concept of time redundancy is the repetition of computations in ways that allow faults to be detected.

What kind of redundancy best suited for design errors ?

Software redundancy is best suited of Design error. Redundant software can occur in many forms; you do not have to replicate complete programs to have redundant software. Software redundancy can appear as several extra lines of codes used to check the magnitude of a signal. Also design diversity in hardware can be useful.

If computer systems only experience permanent faults how it would affect the design ?

Software redundancy would not be needed. As these would be no errors in software.

Question 3

Derive the reliability expression for 5MR system. At what point 5 MR becomes less reliable than 3 MR. Prove your answer analytically.

For 5 MR system

$$\begin{aligned} R_{5MR} &= R^5 + \binom{5}{1}R^4(1-R) + \binom{5}{2}R^3(1-R)^2 \\ &= R^5 + 5R^4(1-R) + 10R^3(1-R)^2 \end{aligned}$$

For 3 MR system

$$\begin{aligned} R_{3MR} &= R^3 + \binom{3}{1}R^2(1-R) \\ &= R^3 + 3R^2(1-R) = 3R^2 - 2R^3 \end{aligned}$$

For $R < 0.5$

$$R_{5MR} - R_{3MR} = -ve$$